mLNG plants Specialities & Challenges

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Technip In LNG
Technip Today

- Worldwide presence with 40,000 people in 48 countries
- Industrial assets on all continents, a fleet of 29 vessels (of which 8 under construction)
- 2013 revenue: €9.3 billion

ENERGY IS AT THE CORE OF TECHNIP
Technip – and LNG in short

- An LNG EPC contractor for over 50 Years
- World’s first LNG plant: CAMEL in Algeria
- Technologically strong: introduced many concepts to the industry that are widely used today
- Leading in floating liquefaction (FLNG)
- Delivered 30% of world LNG production capacity in the last 12 years

Technip – An EPC contractor with own technology
Technip APAC in LNG

- **Technip APAC LNG**
  - LNG Business Unit
  - Competence with SMLNG and involvement in large scale LNG
  - KL-Shanghai-Jakarta

- **Technip APAC experienced in**
  - N2 Expander Cycles
  - SMR
  - C3MR
  - DMR

- **4 SMLNG projects**

- **2 FLNG projects – APAC making a major contribution**
Hanas mLNG – built on technology from large scale projects
Ningxia Hanas - Mid scale LNG in China

- **Contract:** EP(LLL) & CM
- **Execution:** Technip Asia-Pacific
- **Award:** Q2/2009
- **Status:** Start-up
- **2 trains x 0.4 mtpa**
- **Feed gas recompression, Acid Gas Removal Unit (AGRU), Dehydration and Heavy Ends removal (HER), Mercury removal unit (MRU)**
- **Air Products SMR liquefaction process**
- **1 x 50 000m³ FC tank / Whessoe**
- **BOG recompression**
- **Utilities, offsites and general facilities incl. truck loading**
Ningxia Hanas LNG

► Feed gas
  • Conventional field gas from industrial pipeline
  • Pressure & feed varies between summer and winter
  • Feed gas compression to reach optimum liquefaction pressure
  • Operational range: 50% - 100% per train

► Gas treatment
  • Formulated MDEA for CO2 removal
  • Dehydration
  • C6+ and benzene removal
  • Heavy end scrubbing

► Liquefaction
  • 3 bundle MCHE design
  • Fixed speed motor with variable ratio coupling
  • Electrical driven refrigerant compressors
  • Air cooled

► LNG storage
  • Capacity: 50 000 m3
  • Type: Full containment
    • inner tank of 9% Ni steel
    • external tank of pre-stressed concrete
  • Boil off rate: 0.1 % per day

► LNG truck loading
  • LNG: hard loading arms

Picture courtesy of Hanas
Ningxia Hanas LNG

► Offsite
  • Refrigerant storage and make-up
  • Flare – Cold, Warm & tank
  • Condensate storage

► Utilities
  • Electrical - supply from external power grid
  • Hot oil as heating medium
  • Fuel gas – plant heating
  • Nitrogen – blanketing & purging
  • Instrument air
  • Water (demin, portable, service)
  • Fire water

► Assistance to operator
  • Emulated OTS
mLNG Industry
Market drivers for mLNG

- Monetize stranded natural gas resources

- Match the Growing environmental pressure
  - Reduce associated gas flaring
  - Reduce Biogas venting
  - LNG as truck fuel
  - LNG as ship fuel

- Help support remote domestic demand and overcome the absence of distribution grid
  - China
  - India
  - Vietnam

- Low CAPEX investment and ratio CAPEX/tpa of LNG
In recent years there has been an increase in activity in remote areas
- Stranded Gas
- Communities which are isolated
- Where installing a distribution grid is too costly

This is extending in many countries
- China, Indonesia, Vietnam, etc

Potential LNG developments as an alternate fuel to diesel for local transport, shipping, mining industry
- China
- USA
- Brazil
- Thailand
- Europe (Norway, France, Netherlands, …)
Potential mLNG Development in APAC

- China
  - Infra-structure development can not catch-up with quick urbanization
  - Difficult-to-reach area

- Indonesia
  - Many small fields
  - Widely spread energy demand due to archipelago
  - Challenging development of extensive gas pipeline network
Design Challenges of mLNG - China case study
Imbalanced Energy Distribution

- High NG / LNG demand
  - Quick urbanization / coastal development
  - LNG receiving terminal and NG pipeline network construction unable to catch-up

→ Development of “Virtual Pipeline” to distributes energy in LNG form
Pipeline Gas Flow, Pressure Fluctuation & Market Uncertain

- High NG demand during Winter, Low demand during Summer
  - Summer high flow & high pressure
  - Winter low flow & low pressure

  → Fluctuation throughout the year
  → 40% to 100% plant capacity
  → 30% to 100% pressure

- Uncertain LNG market

- Plant utilization of 50%-60%

→ LNG plant with good operation flexibility and excellence specific power at turndown

Design / Operation to maintaining flow & pressure fluctuation whilst maintaining efficiency
Variation in Feed gas composition & HHC fluctuation

- Pipeline gas sources
  - Conventional
    - non-associated gas
    - associated gas
  - Unconventional
    - Coalbed Methane (CBM)
    - Synthetic natural gas (SNG)
    - Shale / tight gas

Source: US Energy Information Administration (EIA)
Variation in Feed gas composition & HHC fluctuation
Heavy Hydrocarbon Removal
- HP Absorber ("Scrub column")

Removal of heavy from rich gas & lean gas with sufficient C2-C5

- Operating pressure < Critical pressure
- MR & C3 cycle make-up
  - Produces limited amount of Ethane and Propane
  - Excess liquid reinjected
- Fractionation section to produce cycles make-up

Traditional method: large LNG
Heavy Hydrocarbon Removal - Turbo-expander process for NGL recovery

Reliable removal from rich gas & lean gas with sufficient C2-C5
- Benzene & heavies removal
- Fractionation section to produce cycles make-up
- Better power saving
- Higher capex

Modern method: large LNG, pipeline gas (used in N. American)
Adsorption process for Heavies removal

Heavy removal for lean gas with limited C2-C5
- Solid adsorption
- Benzene & heavies removal
- Operating pressure > Critical pressure
- Regen gas handling
- External Refrigerant Make-up

Modern method: mLNG, pipeline gas, stable composition
Adsorption – Scrubbing Hybrid Heavies removal

Modern method: mLNG, pipeline gas, variable composition

Removal of heavy from rich gas & lean gas
Variation in Feed gas composition & HHC fluctuation

- Feed gas
  → Variation in composition
    - C1 : 90% → 99%
    - C6+/Bz : 100ppm → >2000ppm
  → Unstable feed composition
    → Composition varies (Lean & Rich)
    → Fluctuation in HHC

→ Good understanding of gas sources
→ Provision of scrubbing and/or adsorption to handle lean & rich gases

Design of Heavy Hydrocarbon Removal System to suit Fluctuation of Heavies
$m$LNG Liquefaction Processes

Simple N2 Expander LNG Process

Multi Stage N2 Expander LNG Process

Source: Air Products
mLNG Liquefaction Processes

Technip experiences in efficient, reliable & proven N2, SMR & C3MR process
Excellent & Proven Technology

Source: Air Products

mLNG

Pre-Cooled MR (C3MR or DMR)

Tradeoffs in Areas of Efficiency, Capital, Operation:

Efficiency
- Plant Capacity
- Power
- OPEX

Capital
- Plant Area
- Plant Config
- EquipCount
- Execution

Operation
- Simplicity
- Flexibility
- Reliability

Source: Air Products

Train Capacity, mta

Source: Air Products
Excellent & Proven Technology

Process Cycle Efficiency Comparison

Process Efficiency (%)

- C3MR: 100
- SMR: 85
- N2: 70

Source: Air Products
Liquefaction Technology Selection

- Liquefaction technologies for \( m \)LNG
  - SMR widely used in China LNG market
  - C3MR / DMR started gaining market
    - Higher CAPEX compare to SMR
    - Better efficiency (10-15% power saving)
    - Water or Air cooled affects efficiency
    - Electrical power price & its future trend
  - Good understanding of all CAPEX & OPEX elements is essential
  - Looks into Plant Life Cycle Cost and Long time return

Proper liquefaction technology selection improve long term return
Motor driven compressor severely impacting external power grid

Mini / Small Scale LNG
- Electric motor driven
- Small motor - low inrush current → not impacting external grid
- Most economical solutions with low electrical power cost

As capacity increase
- CAPEX increase
- Electrical price escalation
- Impacting unstable external grid
- Restart-up difficulties
- Refrigerant loss

More efficient and independent driver solutions whilst maintaining economic approach
Summary of *mLNG* challenges – China case

- Feed & pressure are fluctuating & LNG market is uncertain. LNG plant with good operation flexibility and excellence specific power at turndown.

- Feed gas composition varies and unstable. Proper understanding of gas sources and effective HHC removal is essential.

- Several liquefaction technologies available. Correct understanding of CAPEX, OPEX and life cycle cost with proper technology improve long term return.

- Proper driver selection is essential for good operation of LNG plant.
Thank You